**EPSON**

# E0C6215

## 4-bit Single Chip Microcomputer

Low Voltage
Operation
Products

- ● Core CPU Architecture
- ● Presettable Timer
- ● Analog Multiplexer Comparator
- ● SVD Circuit/Watchdog Timer

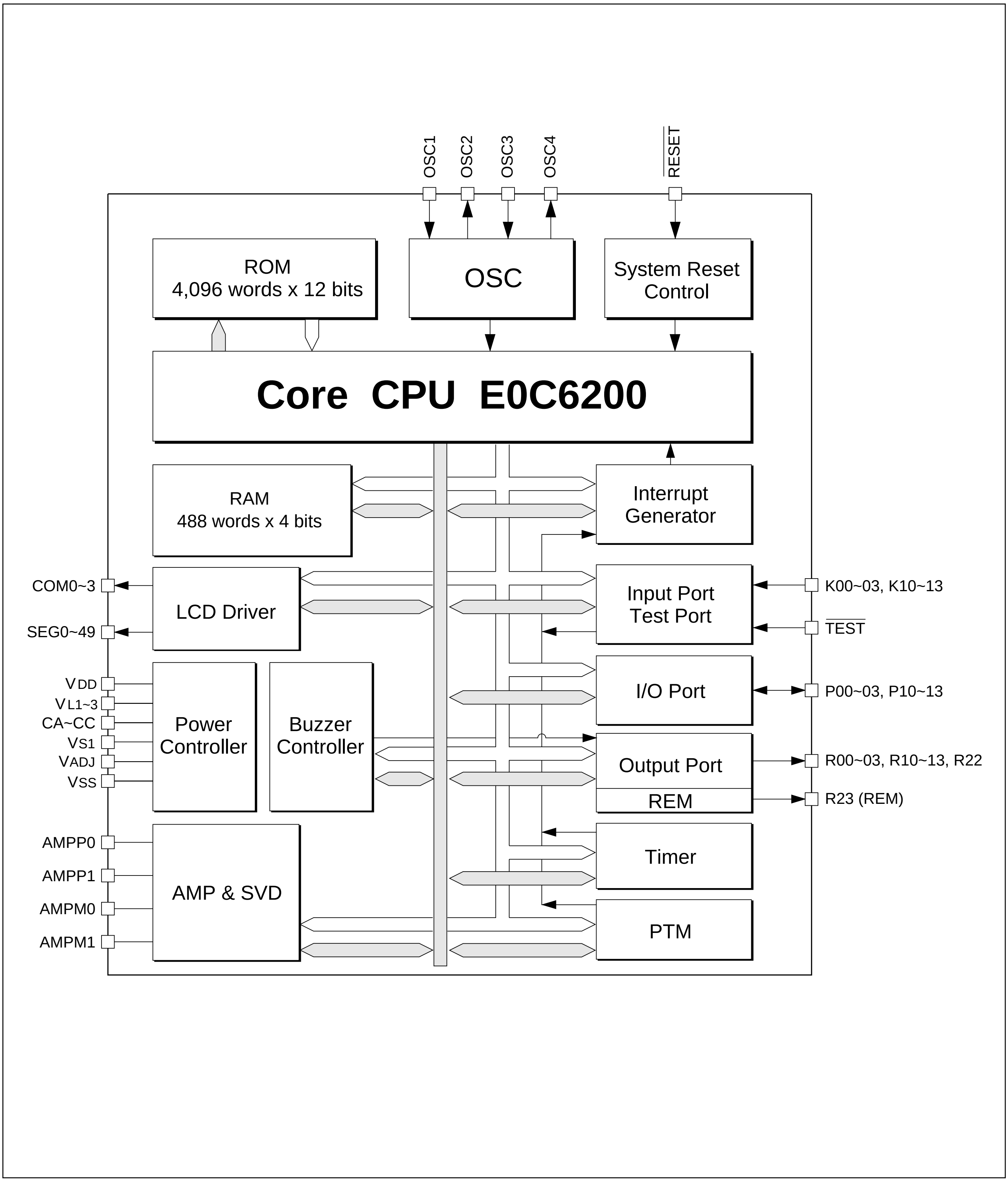
## ■ DESCRIPTION

The E0C6215 is an advanced single-chip CMOS 4-bit microcomputer consisting of the E0C6200 CMOS 4-bit core CPU. It also contains the ROM, RAM, LCD driver, dual timers and comparators to provide an excellent solution for various systems requiring low-power consumption.

## ■ FEATURES

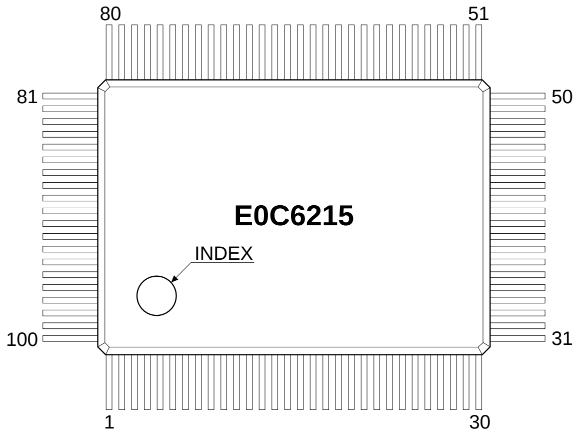
| | |
|---|---|
| ● CMOS LSI 4-bit parallel processing | |
| ● Twin clock | 32.768kHz (Typ.) Crystal oscillation circuit<br>455kHz (Typ.) CR or Ceramic oscillation circuit<br>(selectable by mask option) |
| ● Instruction set | 106 instructions |
| ● Instruction cycle time | 153µsec, 214µsec or 366µsec at 32kHz<br>(depending on instruction set)<br>11µsec, 15µsec or 26µsec at 455kHz<br>(depending on instruction set) |
| ● ROM capacity | 4,096 × 12 bits |
| ● RAM capacity | 488 × 4 bits |
| ● Input port | 8 bits (pull-up resistors are available by mask option) |
| ● Output port | 9 bits (clock output or buzzer output is available by mask option) |
| ● I/O port | 8 bits |
| ● Remote control carrier (REM) output | 1 bit (hardware/software timer is selectable by software) |
| ● LCD driver | 50 segments × 3 commons or 50 segments × 4 commons<br>(1/3 or 1/4 duty is selectable by mask option) |
| ● Built-in LCD power circuit | Voltage regulator (doubler and tripler) |
| ● Built-in SVD circuit | 2.3V ± 0.1V (supply voltage detector) |
| ● Built-in Op-amp | Op-amp for 2-channel analog multiplexer and analog comparator |
| ● Programmable timer | 8-bit presettable count down timer |
| ● Built-in watchdog timer (Mask option) | |
| ● Interrupts | External : Input interrupt 2 lines<br>Internal : Timer interrupt 1 line (3ch.)<br>Presettable timer interrupt 1 line<br>REM interrupt 1 line |
| ● Supply voltage | 3.0V (2.2V to 3.5V) |
| ● Current consumption | HALT mode (32.768kHz) : 3µA (Typ.)<br>OPERATING mode (455kHz) : 150µA (Typ.) |
| ● Package | QFP5-100pin (plastic), QFP15-100pin (plastic)<br>Die form |

## ■ BLOCK DIAGRAM


OSC1
OSC2
OSC3
OSC4
RESET
ROM
4,096 words x 12 bits
OSC
System Reset Control
Core CPU E0C6200
RAM
488 words x 4 bits
Interrupt Generator
COM0~3
SEG0~49
LCD Driver
Input Port
Test Port
K00~03, K10~13
TEST
VDD
VL1~3
CA~CC
VS1
VADJ
VSS
Power Controller
Buzzer Controller
I/O Port
P00~03, P10~13
Output Port
REM
R00~03, R10~13, R22
R23 (REM)
AMPP0
AMPP1
AMPM0
AMPM1
AMP & SVD
Timer
PTM

## ■ PIN CONFIGURATION

**QFP5-100pin**



| No. | Pin name | No. | Pin name | No. | Pin name | No. | Pin name |
|---|---|---|---|---|---|---|---|
| 1 | SEG0 | 26 | R01 | 51 | R22 | 76 | SEG25 |
| 2 | COM3 | 27 | R02 | 52 | SEG49 | 77 | SEG24 |
| 3 | COM2 | 28 | R03 | 53 | SEG48 | 78 | SEG23 |
| 4 | COM1 | 29 | R23(REM) | 54 | SEG47 | 79 | SEG22 |
| 5 | COM0 | 30 | R10 | 55 | SEG46 | 80 | SEG21 |
| 6 | CC | 31 | R11 | 56 | SEG45 | 81 | SEG20 |
| 7 | CB | 32 | R12 | 57 | SEG44 | 82 | SEG19 |
| 8 | CA | 33 | R13 | 58 | SEG43 | 83 | SEG18 |
| 9 | $V_{L3}$ | 34 | P00 | 59 | SEG42 | 84 | SEG17 |
| 10 | $V_{L2}$ | 35 | P01 | 60 | SEG41 | 85 | SEG16 |
| 11 | $\overline{\text{RESET}}$ | 36 | P02 | 61 | SEG40 | 86 | SEG15 |
| 12 | $V_{ADJ}$ | 37 | P03 | 62 | SEG39 | 87 | SEG14 |
| 13 | $V_{L1}$ | 38 | P10 | 63 | SEG38 | 88 | SEG13 |
| 14 | AMPP1 | 39 | P11 | 64 | SEG37 | 89 | SEG12 |
| 15 | AMPM1 | 40 | P12 | 65 | SEG36 | 90 | SEG11 |
| 16 | AMPP0 | 41 | P13 | 66 | SEG35 | 91 | SEG10 |
| 17 | AMPM0 | 42 | K00 | 67 | SEG34 | 92 | SEG9 |
| 18 | $V_{DD}$ | 43 | K01 | 68 | SEG33 | 93 | SEG8 |
| 19 | OSC1 | 44 | K02 | 69 | SEG32 | 94 | SEG7 |
| 20 | OSC2 | 45 | K03 | 70 | SEG31 | 95 | SEG6 |
| 21 | $V_{S1}$ | 46 | K10 | 71 | SEG30 | 96 | SEG5 |
| 22 | OSC3 | 47 | K11 | 72 | SEG29 | 97 | SEG4 |
| 23 | OSC4 | 48 | K12 | 73 | SEG28 | 98 | SEG3 |
| 24 | $V_{SS}$ | 49 | K13 | 74 | SEG27 | 99 | SEG2 |
| 25 | R00 | 50 | $\overline{\text{TEST}}$ | 75 | SEG26 | 100 | SEG1 |

N.C. = No Connection

## ■ PIN DESCRIPTION

| Pin name | Pin No. | In/Out | Function |
|---|---|---|---|
| $V_{DD}$ | 18 | I | Power source (+) terminal |
| $V_{SS}$ | 24 | I | Power source (-) terminal |
| $V_{S1}$ | 21 | O | Oscillation and internal logic system regulated voltage output terminal |
| $V_{L1}$ | 13 | O | LCD system regulated voltage output terminal ($V_{DD}$-$V_L$) |
| $V_{L2}$ | 10 | O | LCD system booster output terminal ($V_{DD}$-2$V_L$) |
| $V_{L3}$ | 9 | O | LCD system booster output terminal ($V_{DD}$-3$V_L$) |
| $V_{ADJ}$ | 12 | I | $V_L$ input adjustment terminal |
| CA–CC | 8–6 | – | Booster capacitor connecting terminal |
| OSC1 | 19 | I | Crystal oscillation input terminal |
| OSC2 | 20 | O | Crystal oscillation output terminal |
| OSC3 | 22 | I | Ceramic or CR oscillation input terminal |
| OSC4 | 23 | O | Ceramic or CR oscillation output terminal |
| K00–03, K10–13 | 42–49 | I | Input terminal |
| P00–03, P10–13 | 34–41 | I/O | I/O terminal |
| R00–03, R10, R11 | 25–28, 30, 31 | O | Output terminal |
| R12 | 32 | O | Output terminal (DC, FOUT or $\overline{\text{BZ}}$ output may be selected by mask option) |
| R13 | 33 | O | Output terminal (DC or BZ output may be selected by mask option) |
| R22 | 51 | O | Output terminal |
| R23(REM) | 29 | O | Remote control carrier output terminal |
| AMPP1 | 14 | I | Analog comparator 1 non-inverted input terminal |
| AMPM1 | 15 | I | Analog comparator 1 inverted input terminal |
| AMPP0 | 16 | I | Analog comparator 0 non-inverted input terminal |
| AMPM0 | 17 | I | Analog comparator 0 inverted input terminal |
| SEG0–49 | 1, 100–52 | O | LCD segment output terminal (Convertible to DC output by mask option) |
| COM0–3 | 5–2 | O | LCD common output terminal |
| $\overline{\text{RESET}}$ | 11 | I | Initial reset input terminal |
| $\overline{\text{TEST}}$ | 50 | I | Test input terminal |

## ■ ELECTRICAL CHARACTERISTICS

### ● Absolute Maximum Ratings

($V_{DD}$=0V)

| Rating | Symbol | Value | Unit |
|---|---|---|---|
| Supply voltage | $V_{SS}$ | -5.2 to 0.5 | V |
| Input voltage (1) | $V_{I}$ | $V_{SS}$ - 0.3 to 0.3 | V |
| Input voltage (2) | $V_{IOSC}$ | $V_{S1}$ - 0.3 to 0.3 | V |
| Operating temperature | Topr | -20 to 70 | °C |
| Storage temperature | Tstg | -65 to 150 | °C |
| Soldering temperature / Time | Tsol | 260°C, 10sec (lead section) | – |
| Permissible dissipation *1 | $P_{D}$ | 250 | mW |

*1: In case of plastic package (QFP5-100pin).

### ● Recommended Operating Conditions

(Ta=-20 to 70°C)

| Condition | Symbol | Remark | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Supply voltage | $V_{SS}$ | $V_{DD}$=0V | -3.5 | -3.0 | -2.2 | V |
| Oscillation frequency (1) | $f_{OSC1}$ |  | – | 32.768 | – | kHz |
| Oscillation frequency (2) | $f_{OSC3}$ | duty 50±5% | 50 | 455 | 500 | kHz |

### ● DC Characteristics

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-2.2 to -3.5V, $V_{L3}$=3.0V, Ta=-20 to 70°C)

| Characteristic | Symbol | Condition |  | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| High level input voltage (1) | $V_{IH1}$ |  | K00–K03, K10–K13<br>P00–P03, P10–P13 | 0.2•$V_{SS}$ |  | 0 | V |
| High level input voltage (2) | $V_{IH2}$ |  | $\overline{\text{RESET}}$ | 0.1•$V_{SS}$ |  | 0 | V |
| Low level input voltage (1) | $V_{IL1}$ |  | K00–K03, K10–K13<br>P00–P03, P10–P13 | $V_{SS}$ |  | 0.8•$V_{SS}$ | V |
| Low level input voltage (2) | $V_{IL2}$ |  | $\overline{\text{RESET}}$ | $V_{SS}$ |  | 0.9•$V_{SS}$ | V |
| High level input current | $I_{IH}$ | $V_{IH}$=$V_{DD}$ | K00–K03, K10–K13<br>P00–P03, P10–P13<br>$\overline{\text{RESET}}$ | – |  | 1 | µA |
| Low level input current (1) | $I_{IL1}$ | $V_{IL1}$=$V_{SS}$, No pull up resistor | K00–K03, K10–K13 | -1 |  | – | µA |
| Low level input current (2) | $I_{IL2}$ | $V_{IL2}$=$V_{SS}$, With pull up resistor | K00–K03, K10–K13 | -5 |  | -0.35 | µA |
| Low level input current (3) | $I_{IL3}$ | $V_{IL3}$=$V_{SS}$<br>Pull up, pull up+feedback | K00–K03, K10–K13<br>$\overline{\text{RESET}}$ | -5 |  | -0.35 | µA |
| Low level input current (4) | $I_{IL4}$ | $V_{IL4}$=0.2•$V_{SS}$<br>Pull up, pull up+feedback | K00–K03, K10–K13<br>$\overline{\text{RESET}}$ | -30 |  | – | µA |
| Low level input current (5) | $I_{IL5}$ | $V_{IL5}$=$V_{SS}$ | P00–P03, P10–P13 *1 | -15 |  | -2 | µA |
| High level output current (1) | $I_{OH1}$ | $V_{OH1}$=0.1•$V_{SS}$ | R00–R03, R10–R13 |  |  | -250 | µA |
| High level output current (2) | $I_{OH2}$ | $V_{OH2}$=0.1•$V_{SS}$ | R22 |  |  | -1.8 | mA |
| High level output current (3) | $I_{OH3}$ | $V_{OH3}$=0.1•$V_{SS}$ | R23 (REM) |  |  | -1.0 | mA |
| High level output current (4) | $I_{OH4}$ | $V_{OH4}$=0.1•$V_{SS}$ | P00–P03, P10–P13 |  |  | -100 | µA |
| Low level output current (1) | $I_{OL1}$ | $V_{OL1}$=0.9•$V_{SS}$ | R00–R03, R10–R13 | 1.0 |  |  | mA |
| Low level output current (2) | $I_{OL2}$ | $V_{OL2}$=0.9•$V_{SS}$ | R22 | 1.0 |  |  | mA |
| Low level output current (3) | $I_{OL3}$ | $V_{OL3}$=0.9•$V_{SS}$ | R23 (REM) | 1.0 |  |  | mA |
| Low level output current (4) | $I_{OL4}$ | $V_{OL4}$=0.9•$V_{SS}$ | P00–P03, P10–P13 | 140 |  |  | µA |
| Common output current | $I_{OH5}$ | $V_{OH5}$=-0.05V | COM0–COM3 |  |  | -3.0 | µA |
|  | $I_{OL5}$ | $V_{OL5}$=$V_{L3}$+0.05V |  | 3.0 |  |  | µA |
| Segment output current (during LCD output) | $I_{OH6}$ | $V_{OH6}$=-0.05V | SEG0–SEG49 |  |  | -3.0 | µA |
|  | $I_{OL6}$ | $V_{OL6}$=$V_{L3}$+0.05V |  | 3.0 |  |  | µA |
| Segment output current (during DC output) | $I_{OH7}$ | $V_{OH7}$=0.1•$V_{SS}$ | SEG0–SEG49 |  |  | -50 | µA |
|  | $I_{OL7}$ | $V_{OL7}$=0.9•$V_{SS}$ |  | 70 |  |  | µA |

*1: Only at read cycle using internal program

## ● Analog Circuit Characteristics and Current Consumption

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-2.2 to -3.5V, Ta=25°C)

| Characteristic | Symbol | Condition | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Internal voltage | $V_{L1}$ | $V_{ADJ}=V_{L1}$, $I_{L1}=5\mu A$ | | -1.13 | -1.05 | -0.98 | V |
| | $V_{L2}$ | Connect 1MΩ load resistor between $V_{DD}$ and $V_{L2}$ (without panel load) | | 2•$V_{L1}$ | | 2•$V_{L1}$ +0.1 | V |
| | $V_{L3}$ | Connect 1MΩ load resistor between $V_{DD}$ and $V_{L3}$ (without panel load) | | 3•$V_{L1}$ | | 3•$V_{L1}$ +0.3 | V |
| SVD voltage | $V_{SVD}$ | | | -2.4 | -2.3 | -2.2 | V |
| SVD circuit response time | $t_{SVD}$ | | | | | 100 | µS |
| AMP offset voltage | $V_{OF}$ | $V_{SS}$=-3.0V, $V_I=V_{DD}$-1.1V to $V_{SS}$+0.1V | | | | 10 | mV |
| AMP response time | $t_{AMP}$ | $V_{SS}$=-3.0V, $V_{AMPP}$=-1.5V, $V_{AMPM}=V_{AMPP}$±15mV | | | | 1.2 | mS |
| Current consumption | $I_{OP}$ | During HALT *1 | $V_{ADJ}=V_{L1}$<br>Without panel load | | 3 | 7.5 | µA |
| | | During operation with OSC1 *2 | | | 4 | 9 | µA |
| | | During operation with OSC3 *3 | | | 150 | 300 | µA |

*1: OSCC="0"

*2: Execution duty: 10% (The SVD and AMP circuits are in the OFF status.), OSCC="0"

*3: Ceramic oscillation (455kHz) or CR oscillation (R=150kΩ), OSCC="1"

## ● Oscillation Characteristics

The oscillation characteristics change depending on the conditions (components used, board pattern, etc.). Use the following characteristics as reference values.

### OSC1 (Crystal)

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-3.0V, Crystal: C-002R ($C_I$=35kΩ), $C_G$=25pF, $C_D$=built-in, Ta=25°C)

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation start time | $t_{sta}$ | $V_{SS}$=-2.2 to -3.5V | – | – | 5 | Sec |
| Built-in capacitance (drain) | $C_D$ | Package as assembled | – | 22 | – | pF |
| | | Bare chip | – | 21 | – | pF |
| Frequency/voltage deviation | ∂f/∂V | $V_{SS}$=-2.2 to -3.5V | – | – | 5 | ppm |
| Frequency/IC deviation | ∂f/∂IC | | -10 | – | 10 | ppm |
| Frequency adjustment range | ∂f/∂$C_G$ | $C_G$=5 to 25pF | 40 | – | | ppm |
| Harmonic oscillation start voltage | $V_{hho}$ | $C_G$=5pF | – | – | -3.5 | V |
| Permitted leak resistance | $R_{leak}$ | Between OSC1 and other pins | 200 | – | – | MΩ |

### OSC3 (CR oscillation)

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-3.0V, $R_{CR}$=150kΩ, Ta=25°C)

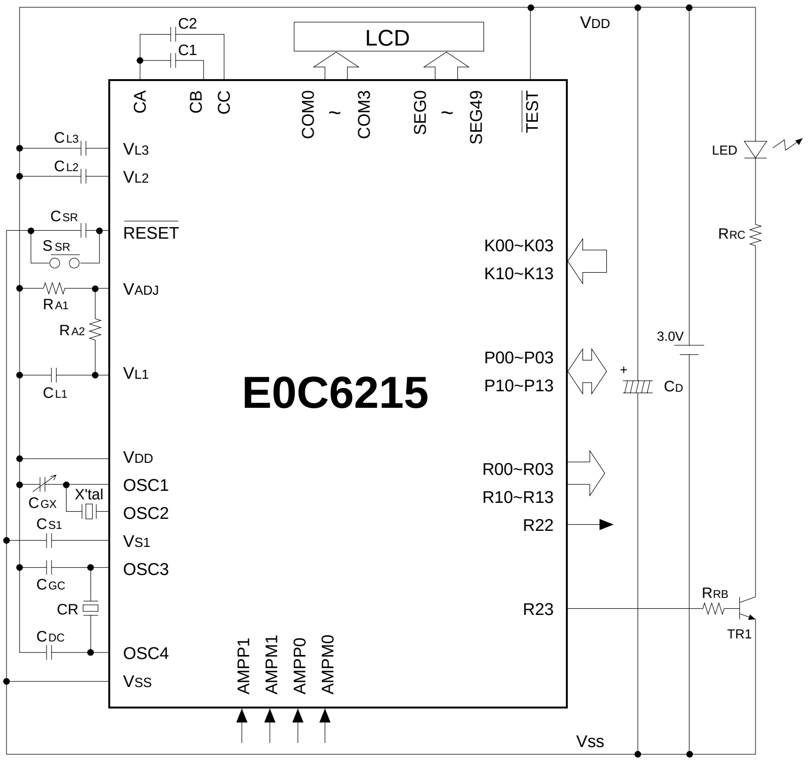
| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation frequency | $f_{OSC3}$ | | – | 280 | – | kHz |
| Oscillation start voltage | Vsta | (Vss) | -2.2 | – | – | V |
| Oscillation start time | $t_{sta}$ | $V_{SS}$=-2.2 to -3.5V | – | 3 | – | mS |
| Oscillation stop voltage | Vstp | (Vss) | -2.2 | – | – | V |

### OSC3 (Ceramic)

(Unless otherwise specified: $V_{DD}$=0V, $V_{SS}$=-3.0V, Ceramic: CSB455E (Murata Mfg. Co.), $C_{GC}=C_{DC}$=100pF, Ta=25°C)

| Characteristic | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Oscillation start voltage | Vsta | (Vss) | -2.2 | – | – | V |
| Oscillation start time | $t_{sta}$ | $V_{SS}$=-2.2 to -3.5V | – | 3 | – | mS |
| Oscillation stop voltage | Vstp | (Vss) | -2.2 | – | – | V |

## ■ BASIC EXTERNAL CONNECTION DIAGRAM

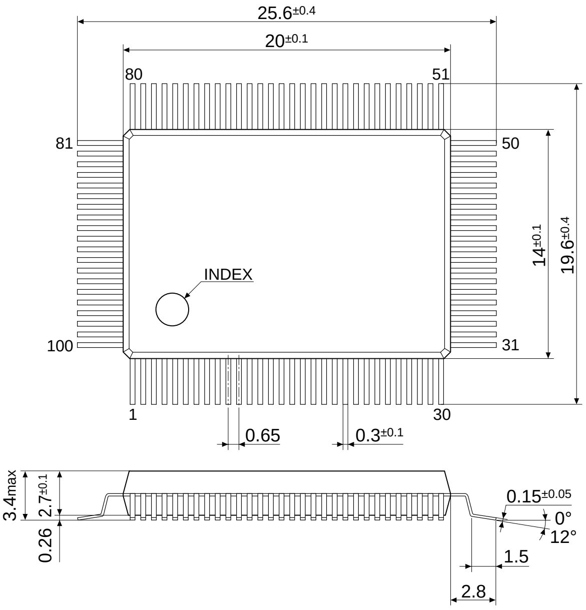

E0C6215
LCD
VDD
VSS
C2
C1
CA
CB
CC
COM0 ~ COM3
SEG0 ~ SEG49
TEST
CL3
CL2
VL3
VL2
CSR
SSR
RESET
RA1
RA2
VADJ
CL1
VL1
VDD
CGX
X'tal
OSC1
OSC2
CS1
VS1
CGC
OSC3
CR
CDC
OSC4
VSS
K00~K03
K10~K13
P00~P03
P10~P13
R00~R03
R10~R13
R22
R23
AMPP1
AMPM1
AMPP0
AMPM0
LED
RRC
3.0V
CD
RRB
TR1

| | | | |
|---|---|---|---|
| X'tal | Crystal oscillator | 32.768kHz<br>$C_I$(Max.)=35kΩ | |
| $C_{GX}$ | Trimmer capacitor | 5–25pF | |
| $C_R$ | Ceramic oscillator | 455kHz | |
| $C_{GC}$ | | 100pF | |
| $C_{DC}$ | | 100pF | |
| $C_{SR}$ | | 0.33µF | |
| $R_{A1}$ | | $V_L$ : 1.5V | $V_L$ : 1.0V |
| | | 2MΩ | Open |
| $R_{A2}$ | | 1MΩ | Short circuit |
| $C_{L1}$ | | 0.1µF | |
| $C_{L2}$ | | 0.1µF | |
| $C_{L3}$ | | 0.1µF | |
| C1 | | 0.1µF | |
| C2 | | 0.1µF | |
| $C_{S1}$ | | 0.2µF | |
| $C_D$ | | 6.8µF | |

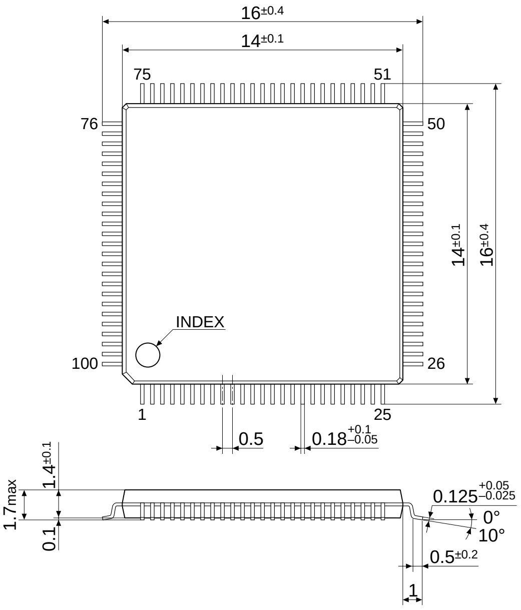
Note: The above table is simply an example, and is not guaranteed to work.

## ■ PACKAGE DIMENSIONS

**Plastic QFP5-100pin**


25.6±0.4
20±0.1
80
51
81
50
100
31
1
30
INDEX
14±0.1
19.6±0.4
0.65
0.3±0.1
3.4max
2.7±0.1
0.26
0.15±0.05
0°
12°
1.5
2.8

**Plastic QFP15-100pin**


16±0.4
14±0.1
75
51
76
50
100
26
1
25
INDEX
14±0.1
16±0.4
0.5
0.18+0.1−0.05
1.4±0.1
1.7max
0.1
0.125+0.05−0.025
0°
10°
0.5±0.2
1

Unit: mm

# E0C6215

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